Part 781-02:
RHODE ISLAND'S ENERGY USE

Rhode Island is the second-lowest energy-consuming state in New England and has one of the lowest per capita energy consumption rates in the United States.

The most significant aspect of Rhode Island's mix of energy sources is, like all of New England, our great dependence on oil. Petroleum clearly is the dominant fuel in the residential and transportation sectors. It accounts for approximately 40 percent of the heating needs in Rhode Island homes, and more than 99 percent of the fuel used for transportation.

In the industrial sector, electricity is the primary energy source, but there is a growing dependence on natural gas. Because present pipeline capacity is limited, many gas customers have back-up fuels in case of supply interruptions or to take advantage of lower prices. Oil or propane provides the desired dual-fuel capability.

Reliable and economical electricity and natural gas is thus crucial for our industrial and commercial sectors, while oil is crucial for residences and transportation. The different energy sources are interdependent as well: oil for a back-up fuel for natural gas, natural gas to power electric generating facilities, etc. With the exception of electricity produced in-state (which may or may not be used in-state, depending on distribution), all these forms of energy originate outside Rhode Island.

New England's electric supply depends on a regional basis on the New England Power Pool (NEPOOL) and Independent Systems Operator New England (ISO-NE). At present, the companies making up NEPOOL own or control over 99 percent of New England's generating capacity. Currently, additional generating capacity is under construction or being planned using gas turbines or, to a much lesser extent, fuel cells, with No. 2 oil as back-up fuel.

As the additional capacity comes on line, it is clear that Rhode Island will become more dependent on natural gas. This is true also for heating in both the commercial and residential sectors.

Presently, only limited forms of renewable energy enter into the Rhode Island energy mix. Minimal hydroelectric generation exists. The possibilities of using wind, wood, solar, and coal have been studied and debated. More of these energy resources have been developed to reduce the state's dependence on oil.

Rhode Island has been in the forefront of developing *least cost* energy programs and conservation and *demand side management* (DSM) programs with the major electric utility in the state, Narragansett Electric Company. Comprehensive energy conservation and energy efficiency programs have been

initiated in state buildings. Rhode Island is in compliance with the requirements outlined in the federal Energy Policy Act, explained later in this plan. Legislation in 2002 extended the funding of the demand side management and renewable energy program. The State Energy Office will oversee the renewable portion of this program.

The newly established Regional Petroleum Reserve, located in Rhode Island, Connecticut and New Jersey, may supplement the Northeast states' access to additional product. This additional reserve is intended to assist these states in meeting their needs during either an oil supply shortage or price spike.

02-01 ELECTRICITY

In New England, the dispatching of electricity from generating plants has been carried out on a regional basis through NEPOOL, and ISO-New England.

Planning has been done both regionally and by the individual utilities. The New England Power Pool provides annual updates on long-range forecasts of electricity requirements in the region. These reports have been instrumental in establishing state policy on power plant construction and energy conservation. They have also been used to predict when shifts in peak demand will occur and how "load management" programs, such as using electricity at off-peak hours to decrease the load on the system, should be tailored.

02-01-01 Power Delivery

The backbone of the New England bulk power transmission system is a network of 230kV and 345kV transmission lines. The regional 345kV power grid is interconnected to the rest of the country by two 345kV tie lines and an additional 230kV tie, all to New York. These are further augmented by four 115kv ties.

There are also connections to Canada. A 345kV tie from Maine to New Brunswick connects the New England grid to the Maritime Power Pool. A 450kV-DC tie to Hydro Quebec was completed in 1985. A line to increase this capacity to 2000MW was completed in 1990.

Three electric companies currently operate in Rhode Island:

1. The *Narragansett Electric Company,* owned and controlled by National Grid USA. Narragansett Electric accounts for about 99 percent of the electricity sales in Rhode Island.

2. The *Block Island Power Company,* generating all the power it sells on Block Island (the Town of New Shoreham). The company's nameplate capacity is 5.55MW.

3. The *Pascoag Utility District,* owned by and serving the taxpayers of the Pascoag Fire District, located in Burrillville. The utility also serves the village of Harrisville. The power the company purchases is delivered to the district's lines by Narragansett Electric, and serves approximately 4,000 customers.

The largest electric generating facility in Rhode Island today is Ocean State Power in Burrillville. Its two units have a capacity of 560MW. Other substantial generators are the re-powered Manchester Street Station in Providence with a nameplate capacity of 495MW, Tiverton Power Associates with 265MW capacity, and Pawtucket Power with 62MW. All of these facilities feed into the regional grid. In 2002, construction was completed on a power plant in Johnston with a 545MW capacity. ((8)), ((9)), ((12))

Current demand in Rhode Island for electricity is approximately 1,650MW. However, even power plants designed for "continuous" operation usually are in service only 40-85 percent of the time, which makes the import and export of electricity between states a routine practice. Hence, regional dispatchers (ISO-NE) and power pools (NEPOOL) are very important in the delivery of power. It also makes the participation of a variety of generators in the power market increasingly important when demand is high.

The New England Power Pool has prepared for electrical energy shortages resulting from different causes and of several magnitudes. The Independent System Operator, ISO-New England, has the responsibility to coordinate service in the individual states during emergencies. Several operating procedures for emergency situations can be found at ISO-NE's web site, **http://www.ISO-NE.com.**

ISO-NE will use the NEPOOL Operating Procedures below to provide energy to any part of the system in the six-state region experiencing shortages:

NEPOOL OP No. 4: Action During a Capacity Deficiency
NEPOOL OP No. 7: Action in an Emergency
NEPOOL OP No. 10: Analysis and Reporting of Power System Emergencies

As an example, Procedure No. 4 will be used by ISO-NE when an emergency shortage of substantial duration is expected. Actions taken by ISO-NE may require some lead time for the states to review. ISO-NE will notify the Rhode Island Division of Public Utilities prior to implementing Procedure No. 4.

Procedure No. 4 lists 16 actions to be taken to cope with a prolonged energy shortage. Action 9 includes the implementation of a *Power Watch.* Step 14 requests generation not contractually available to NEPOOL, as well as requesting load curtailment by large commercial/industrial customers. Step 15 calls for radio and television appeals for voluntary load curtailment and the implementation of a *Power Warning.* Energy consumption restrictions will be

coordinated with the Chair of the Public Utilities Commission, and promoted cooperatively with the electrical utilities.

02-01-02 Cogeneration

Cogeneration may be defined as the production of more than one form of energy (mechanical, electrical, heating or cooling) that is used on site. The generation of electricity in conjunction with the production of steam utilizes what would ordinarily be exhausted as waste heat for purposes that in other situations would require additional energy. This is being looked upon with increased interest in Rhode Island for localized industrial applications. Today's cogeneration systems are quite adaptable to large and small commercial buildings and industrial facilities, and offer each the option of meeting its own electricity and thermal demands at a reduced cost and with increased efficiency. ((6))

A recent report stated that cogeneration facilities in Rhode Island have a total generating capacity greater than 70MW. The largest is Pawtucket Power, which sells the electricity it generates to New England Power, the wholesale subsidiary of National Grid. (Pawtucket Power sells its steam to a manufacturer of cooking oil.) The other cogenerators are small, independent units designed for their own use. Rhode Island's cogeneration units are listed in Table 781-02(1). ((10))

02-01-03 Conservation and Load Management Programs

Since the early 1990's, electric utilities have implemented conservation and load management programs to reduce energy usage and shift power consumption to off-peak hours. Conservation and load management have saved Rhode Island ratepayers money by postponing the need for new power plants.

02-01-04 Conservation in State Buildings

The Rhode Island Department of Administration (DOA) by law (Chapter 37-8-17.1) has operated an energy conservation program in state buildings

Table 781-02(1):
INVENTORY OF COGENERATION FACILITIES IN RHODE ISLAND

Project name	Location	Fuel	Capacity (MW)
Bradford Dyeing	Bradford	Oil	1.00
Brown University	Providence	Gas/oil	3.20
Landmark (Fogarty Hospital)	North Smithfield/Woonsocket	Gas	0.22

Newport Athletic Club	Newport	Gas	0.06
Newport Naval Base	Newport	Gas	2.00
Pawtucket Power	Pawtucket	Gas	68.00
Providence College	Providence	Gas/oil	1.25
Providence YMCA	Providence	Gas	0.22
Rhode Island Hospital	Providence	Gas/oil	4.16
Rhode Island College	Providence	Gas/oil	0.60
South County Hospital	So Kingstown	Gas	0.20
State of Rhode Island — IMH	Cranston	Gas/oil	4.00
Valley Gas	Cumberland	Gas	0.60

Source: State Energy Office, 2001

since 1989. The program has reduced electrical demand by 3.6MW and received over $2.8 million in utility company incentives.

In 1991, the Energy Conservation Revolving Loan Fund was created with monies provided by the U.S. Department of Energy (DOE). The Fund has become an important vehicle for state agencies to conduct cost-effective conservation activities, as utility company rebates are paying less of the share of the cost of projects as part of their DSM programs.

The State Energy Office has recently increased available funding in the Energy Conservation Revolving Loan Fund, and expanded the program to include municipalities. The Loan Fund has replaced direct funding from the Department of Energy for the Institutional Conservation Program (ICP), a 50/50 matching grant program for schools that was eliminated. The Loan Fund thus creates a self-perpetuating fund not only for state agencies, but for municipal buildings. The Loan Fund also finances the incremental cost of alternatively fueled vehicles.

The DOA, along with the Energy Office, is involved in an *Energy Performance Contract* at five DOA buildings, which is anticipated to save $131,000 annually. Energy conservation measures under the Contract include lighting improvements, replacement of steam traps, control systems, and the installation of energy efficient motors.

The Knight Campus of the Community College of Rhode Island (CCRI) in Warwick tentatively awarded a $938,388 contract to install a geothermal system at the campus. Narragansett Electric's share under the Demand Side Management Program was $422,500, leaving $516,388 from CCRI. In order to finance the College's portion, the State Energy Office is lending $400,000 from the Revolving

Loan Fund. This project will save CCRI $40,000 annually in electricity costs. ((24))

The University of Rhode Island is planning to implement an energy conservation project in the amount of $342,000 with a utility rebate of $90,000. The University will borrow $250,000 from the Revolving Loan Fund to finance this project. Implementation of this project will provide energy savings of $46,000 annually.

02-02 NATURAL GAS

Natural gas is not an energy resource indigenous to New England. It must be brought into the region by interstate natural gas pipelines from Texas and Louisiana, and by the Trans-Canada pipeline from Canada into New York and Vermont.

The Algonguin and Tennessee gas companies deliver natural gas to Rhode Island's local distribution system. In Rhode Island, the main local natural gas distributor is the Southern Union Company. Southern Union acquired the service areas of the Providence (ProvGas) and Valley (Valley Resources) gas companies in the last quarter of 2000. These companies now function as divisions of Southern Union. Southern Union purchases its supplies directly from producers and marketers, either under long-term contracts or on the spot market.

Unlike oil, natural gas comes predominantly from domestic sources. Therefore, supply shortages will most likely result from extreme cold weather causing an unusual surge in demand, from interruptions of deliveries through interstate pipelines, from a production slowdown, or from mechanical failures, rather than as a consequence of world politics. Mechanical failures are mostly likely to happen during extreme cold weather, when demand coincidentally is highest, and would probably involve liquified natural gas (LNG) vaporizers and pumps. Interruptions in the delivery of LNG and/or propane to storage facilities may also be a factor in cold weather.

In supply shortage situations, LNG and propane storage facilities may provide some flexibility. Liquified natural gas is supplied by tanker truck from Massachusetts to Algonquin Gas facilities.

The ProvGas service area has a system peak of 170,000MMBtu/day. It can produce up to 134,000MMBtu/day (79% of peak) from its LNG reserves for a period of 11 days before depleting supplies.

The Valley Gas area has a system peak of 35,000MMBtu/day. It can vaporize up to 39,000MMBtu/day (78% of peak) from LNG and propane storage for 4.5 days before depleting supplies.

Natural gas pipeline systems in southern New England include Algonquin Gas, Tennessee Gas, and Iroquois (see Figures 781-02(1) and 781-02(2)). Twenty-five gas utility companies distribute the product in the six New England states. ((6)), ((19)), ((27))

Local distributors purchase their supplies directly from producers and marketers, either under long-term contracts or on the spot market. ((14)), ((19)), ((27)) Both Algonquin and Tennessee supply Southern Union.

02-03 PROPANE

Propane is a colorless, odorless, nontoxic gas. It is easily converted to a liquid by pressure or cooling. It is normally stored and transferred as a liquid under moderate pressure. The majority of propane is derived in the processing of natural gas. It is also produced in the refining of crude oil into gasoline and other petroleum products.

Butane is similar to propane. It is found with propane in natural gas and as a byproduct of crude oil refining. Liquefied petroleum gas (LPG) is propane, butane, or a combination of the two. Propane is the more predominantly used LPG in the United States.

Propane use has increased dramatically in the last 10 years. Residential and commercial customers use it for heating, cooking, and water heating. Tankers into the Omega Terminal at Field's Point, Providence, transport bulk supplies of propane. Other delivery points include C-3 in New Hampshire (waterborne) and Selkirk, New York (pipeline). There are approximately 162,000 accounts in Rhode Island that use propane, totaling approximately 21,000,000 gallons.

Figure 781-02(1):
GAS TRANSMISSION SYSTEMS IN NEW YORK AND NEW ENGLAND

02-04 PETROLEUM

Petroleum products in Rhode Island are received via tanker and barge by the ports of Providence, East Providence, and Tiverton and via tanker truck from terminals in Massachusetts, Connecticut, New York and New Hampshire. Products consist of gasoline, low and high sulfur distillate, diesel fuel, aviation fuel, kerosene, No. 4 and No. 6 heavy oil, and LPG.

The bulk of petroleum products enter the Providence area by barge. Tankers typically are lightered because shoaling problems in the Providence River prevent travel upriver. The majority of storage tank farms are located in Providence, East Providence, and Tiverton. Truck shipments are sometimes received from Connecticut via Hartford and New Haven, and from Massachusetts via New Bedford, Braintree and Quincy.

Gasoline is advertised and sold by brand name, which places it in a unique position relative to any other form of energy. Much of the operation governing production, refining, and retail sales is vertically integrated; that is, a single company such as Exxon or Sunoco produces the crude oil, refines it, and then sells it to individual consumers through their filling stations. There are also a number of retail chains that purchase their gasoline from a major supplier but market it under a house name. In Rhode Island, 18 suppliers serve about three dozen different distributors as well as hundreds of retail gasoline stations. ((14))

Sales of No. 2 fuel oil to homes and businesses, on the other hand, depend on competition only among local heating oil dealers. Price and service in the local market are more important factors than brand name.

According to the Oil Heat Institute, there are 238 licensed oil dealers in Rhode Island serving the homes and businesses that heat with oil. The dealers are supplied by jobbers who transport the oil from marine terminals in the Port of Providence and smaller ports. Large commercial and industrial consumers with considerable on-site storage capacity purchase No. 2 oil directly from the supplier. ((2))

Number 6 oil is a more specialized fuel, used in large boilers for power generation, space heating of large buildings, or process steam production. Users of No. 6 oil usually have abundant on-site storage. ((14))

There is only one petroleum pipeline located within Rhode Island. However, there are no delivery locations in the State of Rhode Island served by this pipeline. Instead it distributes petroleum products shipped into the Port of Providence by ship or barge to Springfield, Mass., and Hartford, Conn. In Rhode Island, the pipeline passes through East Providence, Cumberland, Lincoln and North Smithfield. The pipeline is owned and operated by the Mobil Pipe Line Company and originates at the Mobil Oil Corporation terminal in East Providence. ((14))

02-05 COAL

Anthracite coal is used to heat a very small proportion of Rhode Island residences, the number being around 2000. The coal arrives by trailer trucks from eastern Pennsylvania. There are only two dealers selling coal to residential customers in the state.

Coal-fired power plants, such as Brayton Point in Somerset, Mass., use bituminous coal, which is called "blacksmith coal." It comes from Kentucky, Virginia, Pennsylvania, and West Virginia. ((14))

02-06 RENEWABLE RESOURCES

Renewable resources — wind, solar, photovoltaics, biomass (wood or solid waste), and hydropower facilities — are appealing due to their inherently inexhaustible supply, their relatively benign impact on the environment, their potential to foster energy independence, and other factors. Renewables have played a modest role in Rhode Island's energy mix.

02-06-01 Solar, Wind, and Wood

Driven by projections of high future energy prices, as well as financial incentives from government, vigorous solar, wind energy, wood stove, and photovoltaic industries developed in the United States in the late 1970s and early 1980s. When oil prices fell, and then stabilized, the market's impetus for the development of renewables was removed, and commercial activity dwindled. Government subsidies also dwindled. On June 30, 1995, Rhode Island's sales tax rebate on sales of renewable energy systems expired, thereby removing the financial incentive to purchase such systems.

However, in regions where a number of favorable factors combined — such as easy access to the resource, solar strength, competing power price, and institutional support — significant development of renewables occurred, and continues today. Wind farms in California, Texas and Vermont are good examples of this. ((27)) Another is the strong move in the Northeast toward wood stoves and fireplace inserts, which have made wood something of a home heating staple. The benefits of "passive" solar heating are also enjoyed thanks to modern, energy-conscious home designs that bring both the sun's light and warmth into living spaces.

Although Rhode Island does not receive the extent of solar radiation experienced in southerly climes, "active" solar collection systems have also gained a foothold in the state. As of 1990, there were an estimated 9,000 active collection systems operating in Rhode Island. These include roughly 8,600 domestic hot water systems, 300 swimming pool heating systems, and 100 active space heating systems.

Additions of solar collectors vary from year to year. According to a yearly survey conducted by the U.S. Department of Energy, about 12,000 square feet of solar thermal collectors were shipped to Rhode Island in 1991, and 4,900 square feet in 1992.

Wind energy is theoretically a resource with some potential in Rhode Island. For a time, Block Island had a utility-scale wind turbine, designed for research but not competitive in price with conventional utility power. There remains a handful of small wind machines on Block Island and in other coastal areas in Rhode Island, though the wind resources even along our coast are rather limited.

The combination of burning wood as the primary home heating source, while maintaining electric baseboards or portable electric heaters for back up, is not uncommon. A wood-energy electric generating facility was proposed in Rhode Island in the late 1980s, but no action was taken on that proposal. ((15)), ((22)), ((27))

At present, a 12MW facility, which uses methane (landfill gas), is active at Rhode Island's Central Landfill in Johnston. ((27)) Along with wood, solid waste is considered a biomass fuel.

In 2000, the Rhode Island General Assembly passed S.2280, the Renewable Energy Sales Tax Credit (Chapter 56) and the Residential Renewable Energy System Tax Credit (Chapter 57), re-establishing incentives for renewables. The law provides for a tax credit and sales tax refund to purchasers of solar, wind, and photovoltaic (PV) energy systems.

02-06-02 Hydropower

A hydroelectric plant uses the force of falling water to generate electricity. A typical hydro plant consists of three parts: a pond (impoundment area) where water can be stored; a dam with gates that can be opened or closed to control water flow; and an electric plant where released water is used to spin a turbine that is connected to a generator to produce electricity. ((10))

Today there are about 80,000 dams in the United States, but only 3 percent are used for hydropower. Most were built for flood control, irrigation, or recreational opportunities. ((10)) That is not the case in Rhode Island, where most dams were built to generate power.

Probably only 1 to 3 percent of Rhode Island's total demand for electricity could be met with native hydropower. The Idaho National Engineering Laboratory (INEL) in 1995 identified 30 sites in the state with a total hydropower potential of 13.5MW, 27 of which had the required impoundment or diversion structure but no power generation capability at present. (The remaining three sites had neither power capability nor the required infrastructure.) The potential capacities for individual sites ranged from 24kW to 1.35MW, with most having between 100kW

and 1MW and few or no environmental concerns that would make development unacceptable. ((11))

In 1999, Rhode Island's hydropower generating capability was rated at 4MW in total. This accounted for 6,050MWh of power generation – as opposed to 3,851,282MWh from gas-fired and 2,439,872MWh from oil-fired power plants. ((34))

That should not trivialize the contribution these smaller facilities are making. In certain localized applications, native hydroelectricity *is* supplying the power, just as it did during the early days of the Industrial Revolution. The INEL study suggests more capacity can be developed.

There are, in addition, significant regional contributions from hydropower outside the state. Rhode Island's electricity comes from the ISO-NE regional grid – to which many large hydro facilities sell power, including Hydro Quebec. Hydroelectricity plays a larger role than the number and potential of facilities within the state suggest.

02-06-03 Geothermal

The earth absorbs 47 percent of the sun's energy, more than 500 times more energy than mankind needs every year. The absorption and release of heat from the sun by the earth is the physical principle that *geothermal* or *geoexchange* systems use to provide heating in the winter and cooling in the summer. ((1)), ((24))

A geoexchange heat pump system typically uses a liquid medium – groundwater or an antifreeze solution – to effect heat transfer for heating, cooling, or providing hot water. Energy consumption is 25 to 50 percent less with geoexchange systems than traditional oil, natural gas and electric heat pumps. Because geoexchange systems burn no fossil fuels they do not produce greenhouse gases, thus eliminating a source of carbon monoxide inside the homes and commercial buildings where they are used.

The U.S. Environmental Protection Agency (EPA) found that, even on a source-fuel basis, geoexchange is on average 48 percent more efficient than gas furnaces and over 75 percent more efficient than oil. In fact, today's best geoexchange systems outperform the *best* gas technology by an average of 36 percent in heating mode and 43 percent in cooling mode. The efficiency gain is explained by geoexchange systems providing either heating or cooling by *moving* heat rather than by converting chemical energy.

In 1997 the United States Department of Energy awarded a special project grant to promote and or accelerate the increased use of geothermal heat pumps in the New England area. As a result, the Community College of Rhode Island used a portion of these funds to engineer a feasibility study at its Knight Campus. As mentioned in Section 02-01-04, CCRI later awarded a contract to install a

geothermal system on campus that is expected to save tens of thousands of dollars each year in electricity costs. ((24))

02-07 CONSUMPTION PATTERNS

02-07-01 Overall Consumption

Between 1992 and 1999 the overall use of energy increased in Rhode Island by 4 percent. Fossil fuels (e.g., petroleum, natural gas and coal) accounted for about 94 percent of the state's energy consumption (Table 781-02(2), Figure 781-02(3)).

Gasoline, home heating oil, LPG and other petroleum products have historically provided Rhode Island with about three-quarters of its *primary energy consumption*. Oil is significant in end-uses in every consuming sector, but it is absolutely dominant in transportation. ((21)) Only very modest inroads have been made in the use of compressed natural gas (CNG) in fleets and public transit, and hybrid gasoline/electric vehicles are still little more than a novelty among individual consumers.

Residential consumption estimates indicate the majority of homes in Rhode Island heat with oil. Households preferring gas in areas where service is not available by pipeline use liquefied petroleum gas (LPG) for heating and cooking. ((14)) On a per-barrel basis, residential use of LPG is about 9 percent that of fuel oil. ((21))

Oil and natural gas are also used as a fuel for power plants — generating another form of energy, electricity. Oil is found as a back-up fuel for some natural gas-fired plants, such as Ocean State Power in Burrillville.

Table 781-02(2):
RHODE ISLAND ENERGY CONSUMPTION BY SOURCE, 1992-1999

By Btu value:	Coal	Natural gas	Petroleum	Hydro	Biomass*	Total
			(trillion Btu)			
1992	0.1	79.2	100.5	6.7	4.6	191.1
1993	0.1	77.8	98.2	8.8	4.9	189.8
1994	0.1	73.3	101.5	8.8	4.7	188.4
1995	0.1	72.0	98.3	9.2	5.1	184.7
1996	0.1	87.7	97.1	9.7	5.3	199.9
1997	0.1	84.9	103.4	11.1	3.8	203.3
1998	0.1	88.3	97.3	9.6	3.7	201.0
1999	<0.05	86.1	98.9	10.0	4.1	199.0

*Biomass = primarily wood, waste
Source: Energy Information Administration, 2001

The Ocean State Power facility has a 20-year contract to purchase 100MMCF per day of natural gas from Alberta for its two generating units. Ocean State Power, along with Tiverton Power and Manchester Street Station, came on line during the 1990s and are factors in the dramatic increase in the use of natural gas in recent years. This trend in the consumption of natural gas is seen throughout the country. Rhode Island's 1999 energy consumption figures by source, expressed as percentages of total Btu value, show the share of natural gas increasing from its 1992 level by 5 percent (Figure 781-02(2)).

A report by the Rhode Island Attorney General's Office states that the increase in natural gas consumption is also attributable to the electricity market's promoting fuel switching where possible from oil to natural gas.

Because it burns more cleanly than oil or coal, natural gas has now become not only the fuel of preference for new electric generating facilities, but also essentially the only "acceptable" (i.e., most easily permitted) fuel for such plants. As a result, nearly all new generation planned or under construction is natural gas-fired. Although natural gas has been used for number of years as a fuel for peaking generators based on the combustion turbine, its role was limited. However, natural gas is now being used with increasing frequency to meet power generation requirements throughout the year.

The traditional lines between "baseload" and "peaker" plants have blurred because of electric industry deregulation. New plants are now seen as "market" plants, theoretically on-line constantly rather than switching on or off to meet cycles in demand. The result is a dramatic increase in the growth rate for natural

Figure 781-02(2) here

gas as a fuel for electric power generation purposes, a growth now projected to continue at least through 2010. ((4))

Independent System Operator New England, which manages the regional power grid, has expressed the concern that demand for natural gas for electric generation is liable to outstrip supply by winter, 2003. The problem is exacerbated by limits in the capacity of existing pipelines to deliver natural gas to the region. The situation is not helped by the fact that the newest Rhode Island power plants, Tiverton Power and RISE in Johnston, use gas without a backup fuel, i.e., oil. ((29)) While power plants may be affected, gas utilities, such as Providence Gas and Valley Gas, should not have a problem supplying for their heating customers, according to a spokesman for the New England Gas Association. The utilities have taken the position that they will not yield "any capacity on the pipelines" to electric generators. ((29:A4))

. As Table 781-02(2) indicates, the consumption of sources of energy other than natural gas or oil either remained constant (coal), or increased and declined in varying degrees (hydropower, biomass) between 1992 and 1999. ((21)) Most of the *overall* increase in "other sources" shown in Figure 781-02(3) is attributable to a growth in hydropower imports from Canada rather than in small, local hydro facilities. While the contribution of coal in industrial applications or electric generating plants did not grow and biomass was eclipsed by hydro, some homes still rely on coal or wood stoves for space heating. ((14))

02-07-02 Consumption by Sector and Source

Energy use is divided into four sectors — residential, commercial, industrial and transportation. Between 1992 and 1999 there has been an overall increase in energy consumption, with the commercial sector showing the largest gain overall, 17 percent (Table 781-02(3)). However, the increases observed in the commercial sector peaked in 1996, and consumption began falling in 1997 and 1998, rising again in 1999. Several financial services firms relocated to Rhode Island during 1999, which may account for the slight increase.

Industrial use accounted for 33 percent of Rhode Island's energy consumption in 1999, the most recent year for which such data are available; transportation, for 31 percent; residential, 22 percent; and commercial, 14 percent (Figure 781-02(4)). In 1992, 1993, 1994 and 1999, the industrial sector registered the highest consumption, but the transportation sector led in 1990, 1991, 1995, 1996, 1997 and 1998 (Table 781-02(3)). The increase in the transportation sector during this period reflects an increase in the use of sport utility vehicles (SUVs), which consume up to 50 percent more gasoline than more conventional, fuel-efficient cars. ((17))

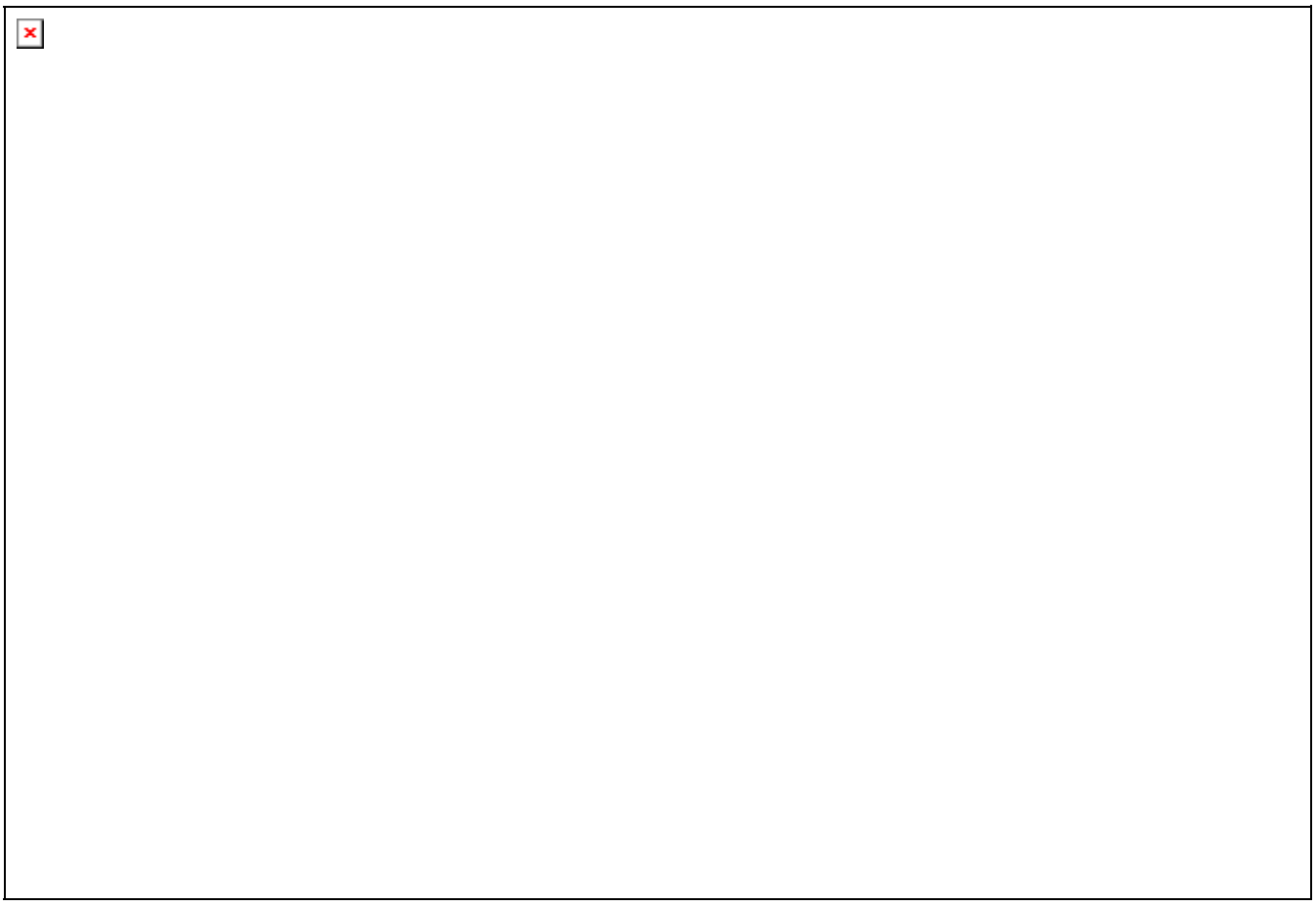
Table 781-02(3):
RHODE ISLAND NET ENERGY CONSUMPTION BY SECTOR
1992-1999

	Coal	Natural gas	Petroleum	Electricity	Biomass	Total
			(trillion Btu)			
Residential						
1992	0.1	20.4	20.2	8.1	3.4	52.2
1993	<0.05	20.3	20.5	8.2	3.5	52.5
1994	<0.05	17.9	21.8	8.4	3.4	51.5
1995	<0.05	17.8	20.7	8.4	3.8	50.7
1996	<0.05	20.2	22.0	8.5	3.8	54.5
1997	<0.05	18.6	23.0	8.5	2.4	52.5
1998	<0.05	16.9	21.0	8.6	2.1	48.6
1999	<0.05	17.0	19.7	9.1	2.3	48.1
Commercial						
1992	<0.05	9.2	7.2	9.1	NA	25.5
1993	<0.05	9.5	8.0	9.3	0.3	27.1
1994	<0.05	12.4	9.0	9.3	0.3	31.0
1995	<0.05	12.4	7.8	9.5	0.3	30.0
1996	<0.05	13.2	9.3	9.5	0.3	32.3
1997	<0.05	12.6	8.9	9.6	0.3	31.4
1998	<0.05	11.8	6.9	9.9	0.3	28.9
1999	<0.05	12.1	6.2	11.3	0.3	29.9
Industrial						
1992	0.0	48.8	15.6	4.6	1.0	70.3
1993	0.0	47.4	12.1	4.8	1.1	65.4
1994	0.0	42.1	14.3	4.7	1.0	62.1
1995	0.0	36.0	11.7	4.7	1.0	53.4
1996	0.0	27.7	7.2	4.6	1.2	40.7
1997	0.0	25.0	6.8	4.7	1.1	37.6
1998	0.0	43.3	6.4	4.9	1.3	55.9
1999	0.0	56.8	7.0	4.0	1.5	69.3
Transportation						
1992	0.0	0.4	56.4	0.0	0.0	56.8
1993	0.0	0.2	57.2	0.0	0.0	57.4
1994	0.0	0.4	55.9	0.0	0.0	56.3
1995	0.0	0.6	57.6	0.0	0.0	58.2
1996	0.0	0.7	58.1	0.0	0.0	58.8
1997	0.0	0.9	64.5	0.0	0.0	65.4
1998	0.0	0.4	62.8	0.0	0.0	63.2
1999	0.0	0.3	65.6	0.0	0.0	65.9

Biomass = wood and waste; NA = data not available

Figure 781-02(3):
RHODE ISLAND ENERGY CONSUMPTION BY SECTOR, 1999

As percentage of total BTU, rounded to nearest whole number



Source: Energy Information Administration, 1999

A strong preference for natural gas is indicated in the industrial sector as shown in Figure 781-02(5) – where it takes nearly four-fifths of the "pie," being used for heating, cooling, and industrial processes. In contrast, the transportation sector as a whole uses very little natural gas (CNG), and over 99 percent of its energy comes from petroleum. Motor gasoline alone constitutes more than half the energy demand in transportation. ((20))

In terms of total Btu value of energy consumption, petroleum leads in Rhode Island homes, followed by natural gas (41 percent *vs.* 35 percent). Electricity accounts for 19 percent. These figures are not based solely on energy consumed for heat, but for cooking and drying laundry as well. Electricity use is increasing with the growing demand for air conditioning, consumer appliances, telecommunications and industrial equipment. Wood use by Btu value is about 5 percent total consumption, while coal use is negligible. The data suggest that the popularity of wood or coal as a fuel fluctuates with the price of home heating oil, which in the late 1990s was relatively cheap.

In the commercial sector, natural gas use takes 40 percent of the "pie," while electricity and petroleum take 38 percent and 21 percent, respectively (Figure 781-02(5)). ((21))

02-07-03 Alternative Motor Fuels and Fuel Cells

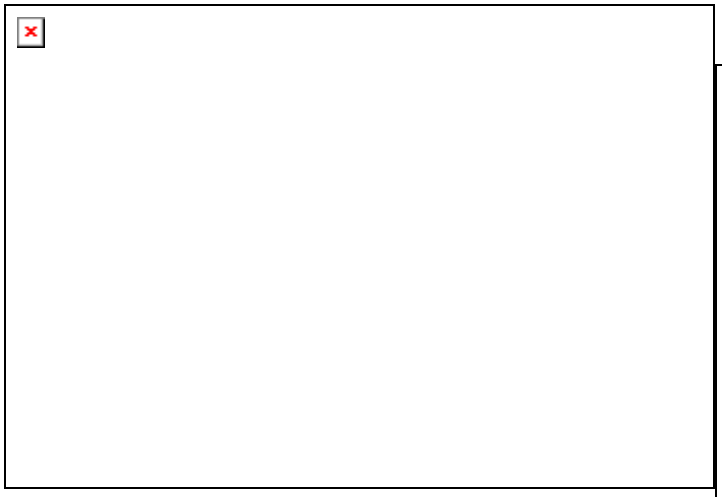
Passed in 1992, the Energy Policy Act (EPACT) established a firm energy policy to reduce America's dependence on foreign oil. EPACT was also intended to reduce noxious emissions from oil consumption. The act set a national goal of replacing 10 percent of the petroleum used in light duty vehicles with non-petroleum alternative fuels by 2000 and 30 percent by 2010. EPACT required federal fleets to purchase Alternative Fuel Vehicles (AFVs) beginning in fiscal year 1993. In March 1996, the DOE issued final rulings making mandatory the purchase of light duty AFVs by state fleets and fuel providers.

New light duty AFV vehicle purchases for federal and state governments have reached 75 percent of total purchases whereas utility providers are at 90 percent. These mandates have increased the number of CNG AFVs in Rhode Island. With these purchases comes the problem of adequate infrastructure to fuel these fleets and money is being provided by the Federal Department of Transportation's special program called *Congestion Mitigation and Air Quality* (CMAQ). The State of Rhode Island has used CMAQ funds for both the incremental costs of vehicles and the infrastructure to support them.

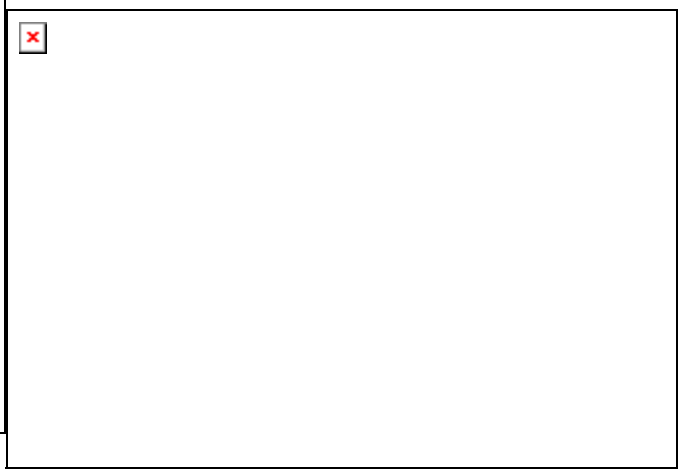
In 1997 a public-private partnership was formed within the State of Rhode Island called the Ocean State Clean Cities Coalition, which is a voluntary, locally based initiative to expand the awareness and use of alternative gas and diesel fuels. The Coalition's goals include improving air quality, encouraging economic

Figure 781-02(4):
SECTOR ENERGY CONSUMPTION BY SOURCE, RHODE ISLAND, 1999

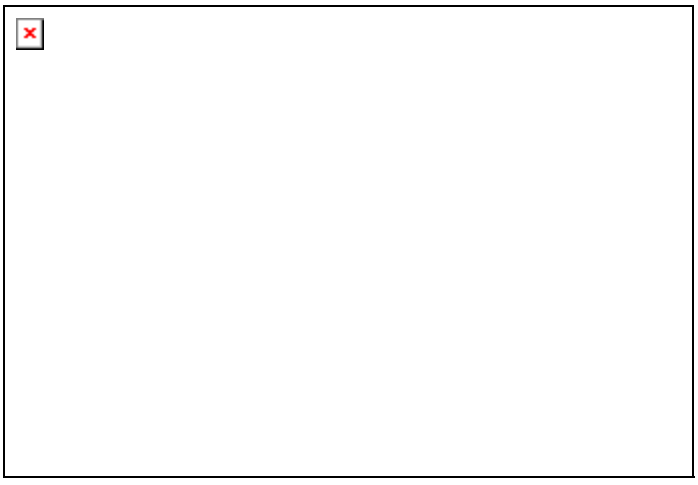
Transportation



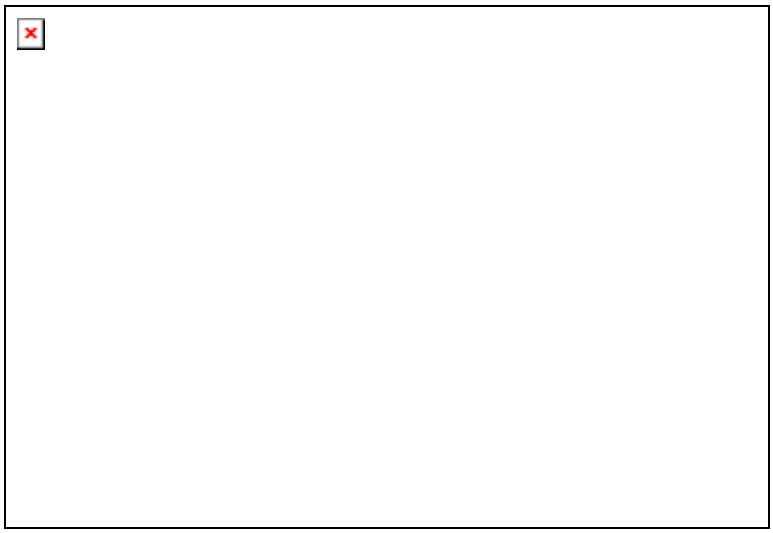
Commercial



Industrial



Residential



growth and increasing energy independence. The Coalition is also working to expand the publicly accessible refueling infrastructure through a universal card system.

Nationally, the DOE is working on infrastructure development, cost reduction, and vehicle range improvements to achieve consumer acceptance of AFVs as well. The DOE's Clean Cities Program seeks to establish a self-sustaining AFV infrastructure by involving federal, state, and local governments, fuel suppliers, vehicle manufacturers, consumers, fleet managers, utilities, and environmental groups.

The National Gas Vehicle Coalition (NGVC) reported that total alternative fuel use accounted for less than 4 percent of all highway gasoline use in 1998. Although the use of alternative fuels has fallen short of the Energy Policy Act's goal, a number of gains have been made. As mentioned above, the type and number of alternative fuel vehicles (AFVs) being sold has grown. Automobile manufacturers such as General Motors, Honda, Ford, and Daimler-Chrysler have produced an array of low-emission vehicles using conventional technology, and have begun selling or leasing hybrid, CNG, or all-electric models. These include passenger cars, light duty trucks, school buses, and transit buses.

Mazda, Ford, and other manufacturers have also begun testing autos powered by fuel cells. Fuel cells are two electrodes sandwiched around an electrolyte which harness the chemical energy of hydrogen and oxygen to generate electricity without combustion or pollution. Vehicles with fuel cells are claimed to be quieter, cleaner, and more energy efficient than those with gasoline engines, yet have equivalent range and performance. Benefits include cleaner air, creation of new markets for equipment suppliers, and reduction in our dependence on petroleum imports. The DOE projects that if 10 percent of automobiles nationwide were powered by fuel cells, oil imports would be cut by 800,000 barrels a day, and regulated air pollutants would be cut by 1,000,000 tons a year. Sixty million tons of the greenhouse gas carbon dioxide would be eliminated as well. ((25))

In September 1998, at the 16th National Natural Gas Vehicle (NGV) Conference and Exposition, Rhode Island celebrated the implementation of its AFV Incentive Act of 1997. The benefits the legislation provides for AFVs include:

- A 50% tax credit for companies for the incremental cost of AFVs, and a similar tax credit for the capital, labor, and equipment costs associated with conversions

- A business tax credit on the cost of building or making improvements to alternative refueling or recharging stations

- Exemption from the gasoline tax for any alternative fuels used by companies operating fleets of 10 or more vehicles

- Exemption from the state sales tax for the incremental cost of purchasing a new AFV and the cost of conversions

- Deductions from the gross earnings tax for the total gross earnings realized through the sale of alternative fuels used to power motor vehicles

- Exemptions from the state sales and use tax on alternative fuel sold, stored, or consumed the state

In January 1999, the Rhode Island State Energy Office began providing interest-free loans for a 5-year period to state agencies and municipal governments to cover the incremental costs of original equipment manufacturer AFVs. On the private sector side, ProvGas provided rebates and incentives for natural gas vehicle use on a case-by-case basis through its demand side management program.

Fuel blending is complementing these efforts. The Biodiesel Fuel Use Credit Interim Final Rule, issued by DOE in May, 2000, allows fleets required to purchase AFVs under the Energy Policy Act to meet up to 50 percent of their acquisition requirements through the use of biodiesel blends, such as B20, in vehicles of 8,500 lbs. gross vehicle weight or greater. B20 is a blend of 20% biodiesel — which is made from soybean or other vegetable oils or animal fats — and 80% diesel fuels. With the new option, a fleet can get credit for one AFV purchase by using 450 gallons of 100% biodiesel. ((3))

To support the AFVs purchased under the EPACT mandate and otherwise, the state is expanding its alternative fueling stations with facilities proposed or existing in Providence, Cumberland, Middletown, North Kingstown, Cranston and Warwick.

In June 1999, RIPTA added 15 CNG powered trolleys to its mass transit system The trolleys, transporting passengers in downtown Providence and Newport, will reduce airborne pollutants in the two cities.

The commercial success of these initiatives, and their impacts on overall energy consumption, will depend on whether AFVs prove themselves a worthwhile and cost-efficient alternative to their more conventional counterparts powered by gasoline or diesel fuel. Compressed natural gas, for example, needs to develop a track record regarding performance, fuel economy, safety, emissions control and convenience before it wins consumer acceptance. Targeted rollbacks in motor fuel taxes and accommodations in environmental regulations, such as the biodiesel option, should have an impact on further development of these technologies as well.